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Stahlecker

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[54] **METHOD AND APPARATUS FOR OPERATING AN OPEN-END FRICTION SPINNING MACHINE**

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[51] **Int. Cl.**[4] **D01H 13/22;** D01H 13/32

[52] **U.S. Cl.** **57/264;** 57/265

[58] **Field of Search** 57/22, 263, 264, 265, 57/93

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Attorney, Agent, or Firm—Barnes & Thornburg

[57] **ABSTRACT**

A method and apparatus for operating an open-end friction spinning machine with a plurality of spinning units whereby yarn twist of yarn at the spinning units is monitored by a measuring and evaluating device. This monitored yarn twist is then compared with a predetermined desired yarn twist value. In response to deviations from the predetermined desired yarn twist, at least one parameter of spinning conditions is adjusted.

26 Claims, 8 Drawing Figures

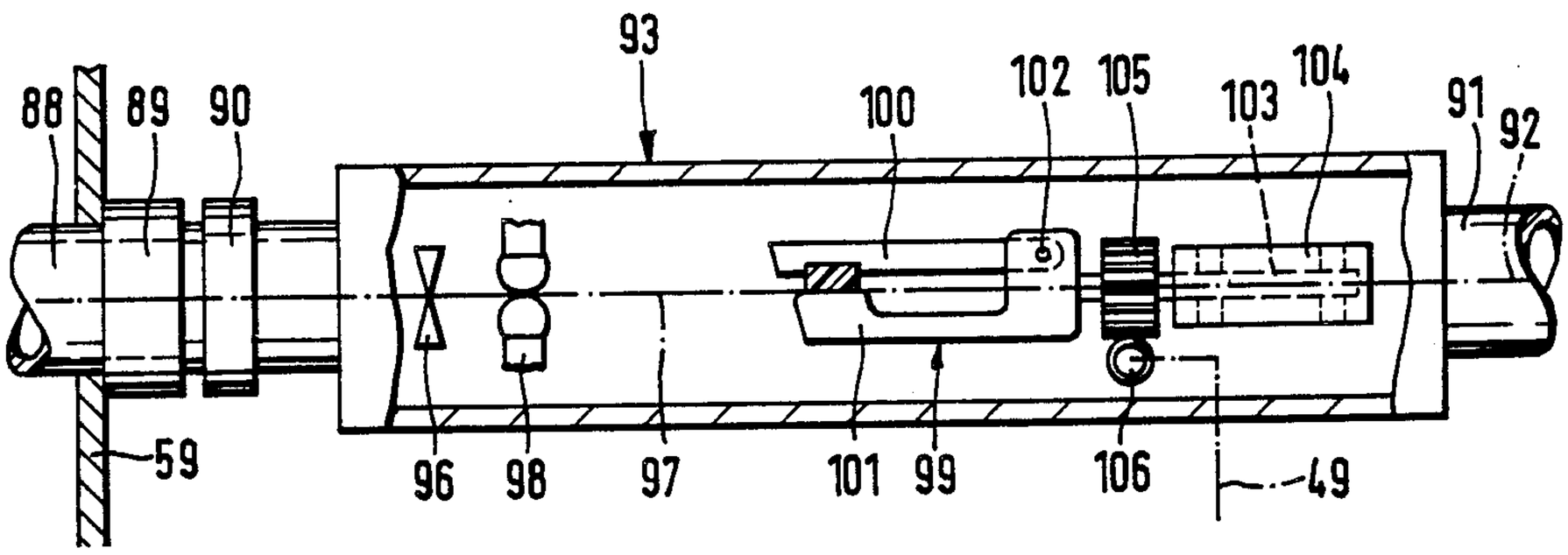

Fig. 1

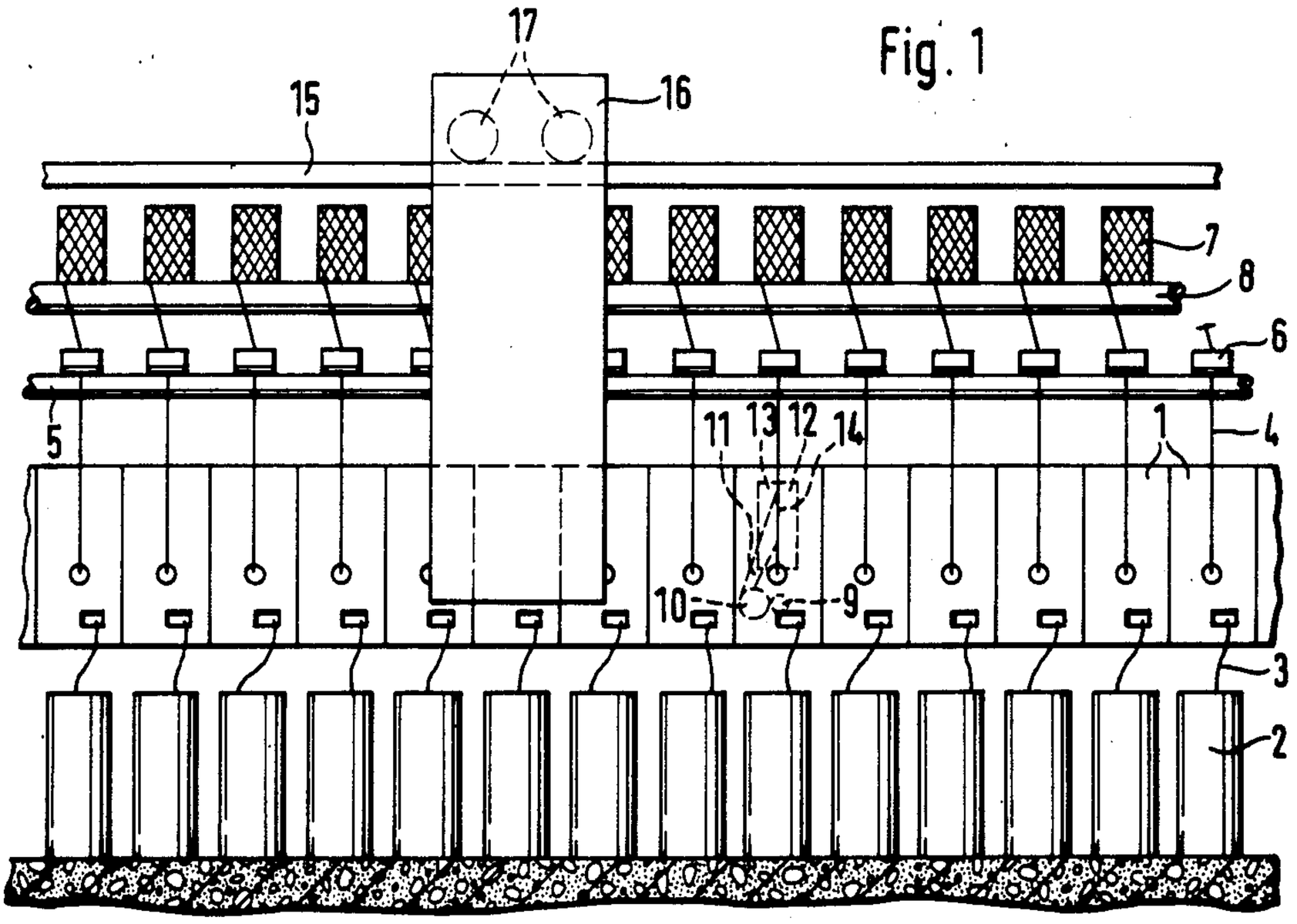

Fig. 2

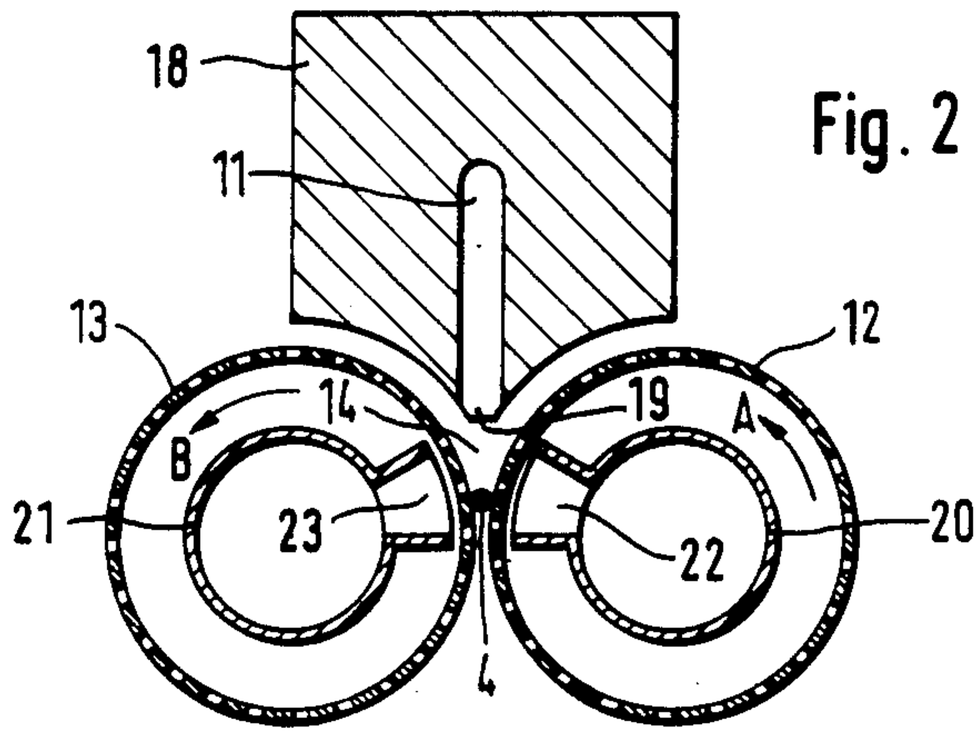

Fig. 3

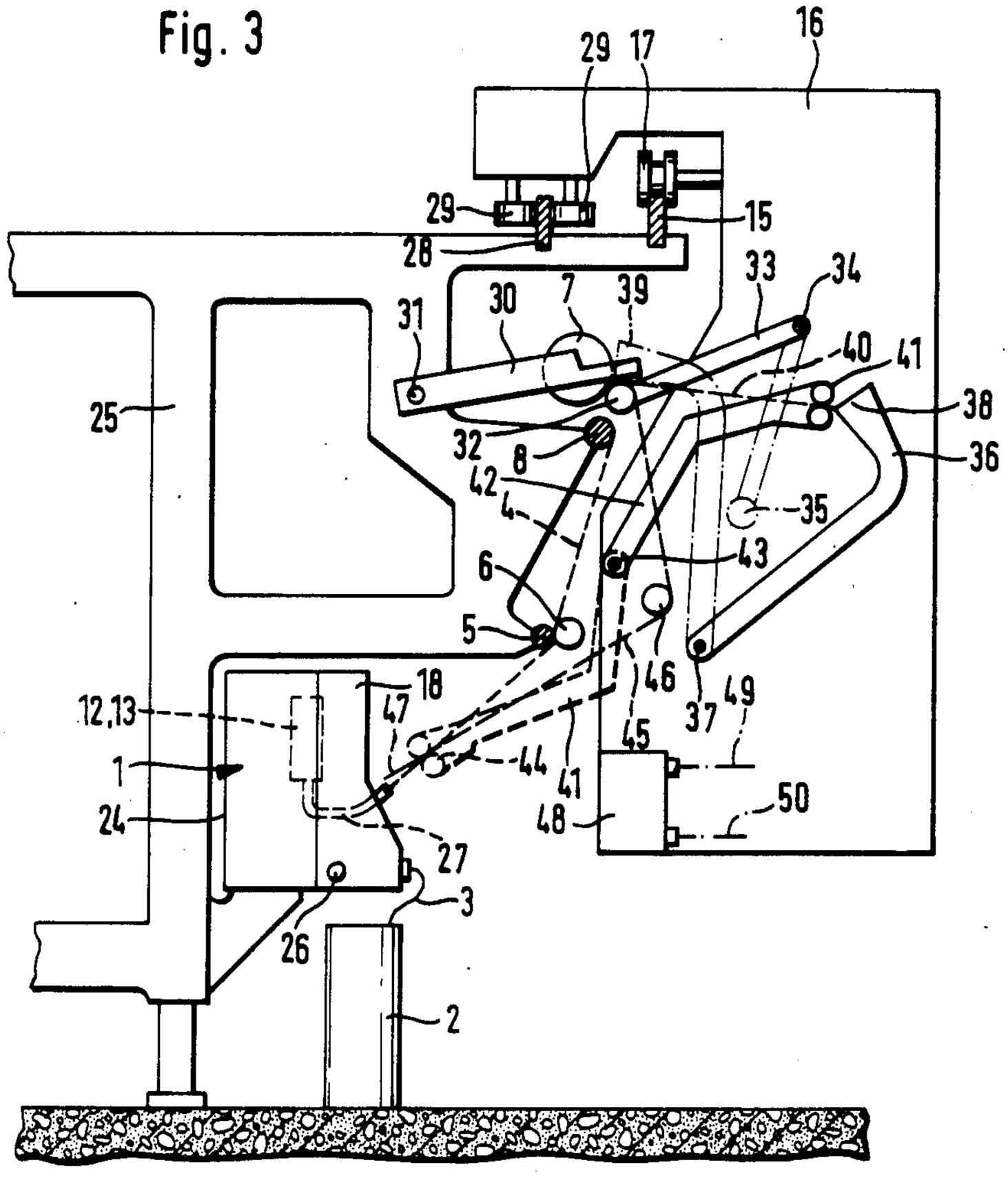
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Fig. 4

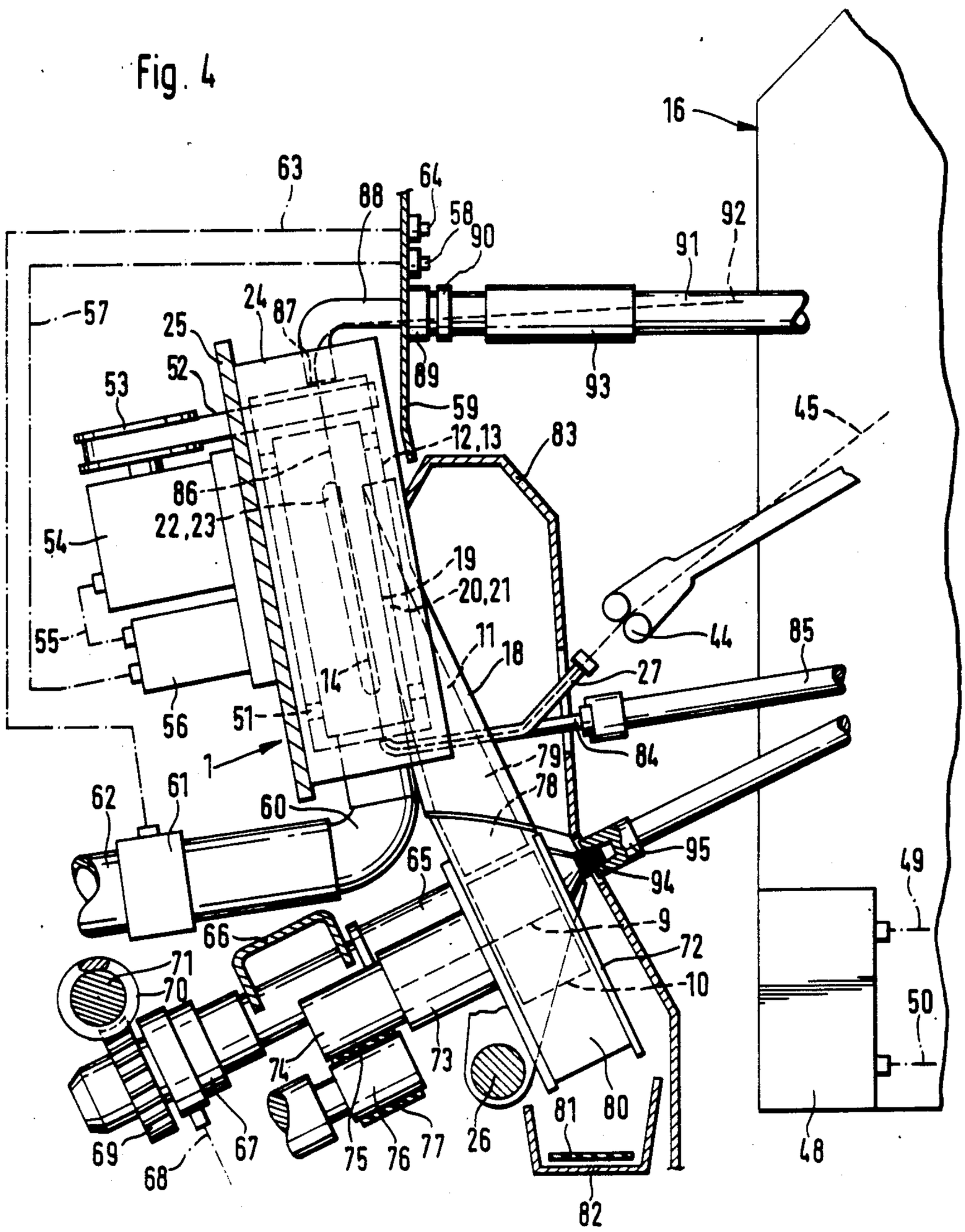
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Fig. 5

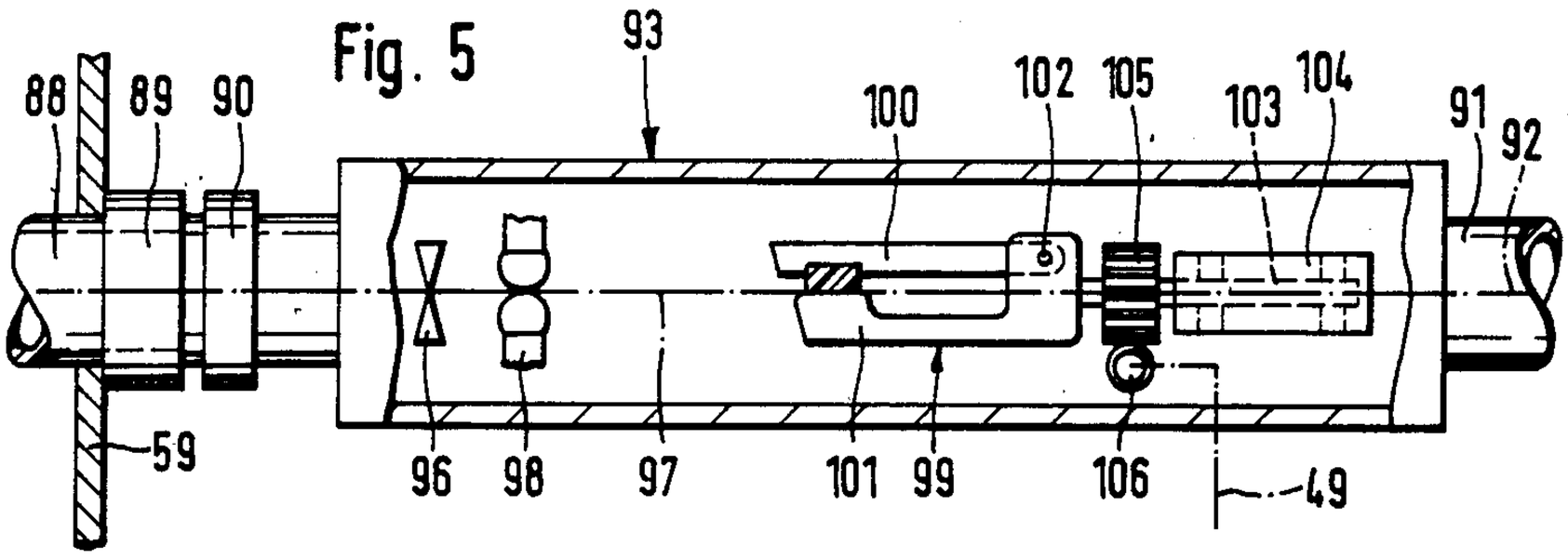


Fig. 6

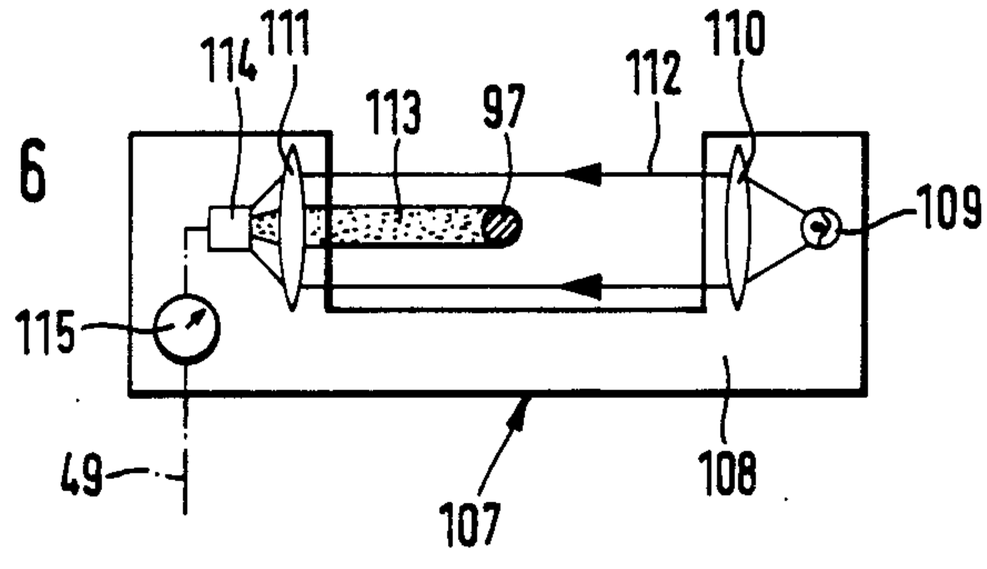
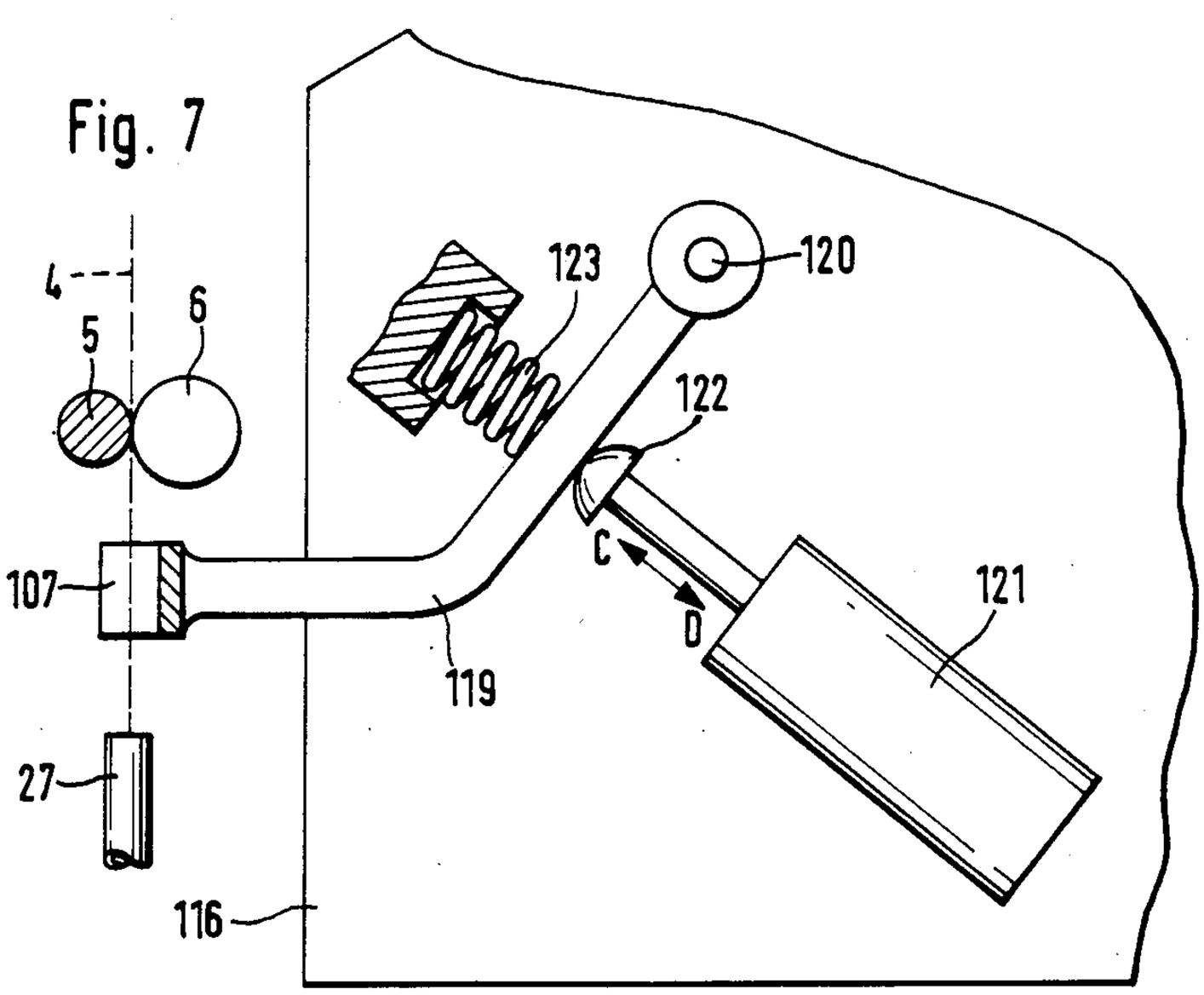


Fig. 7



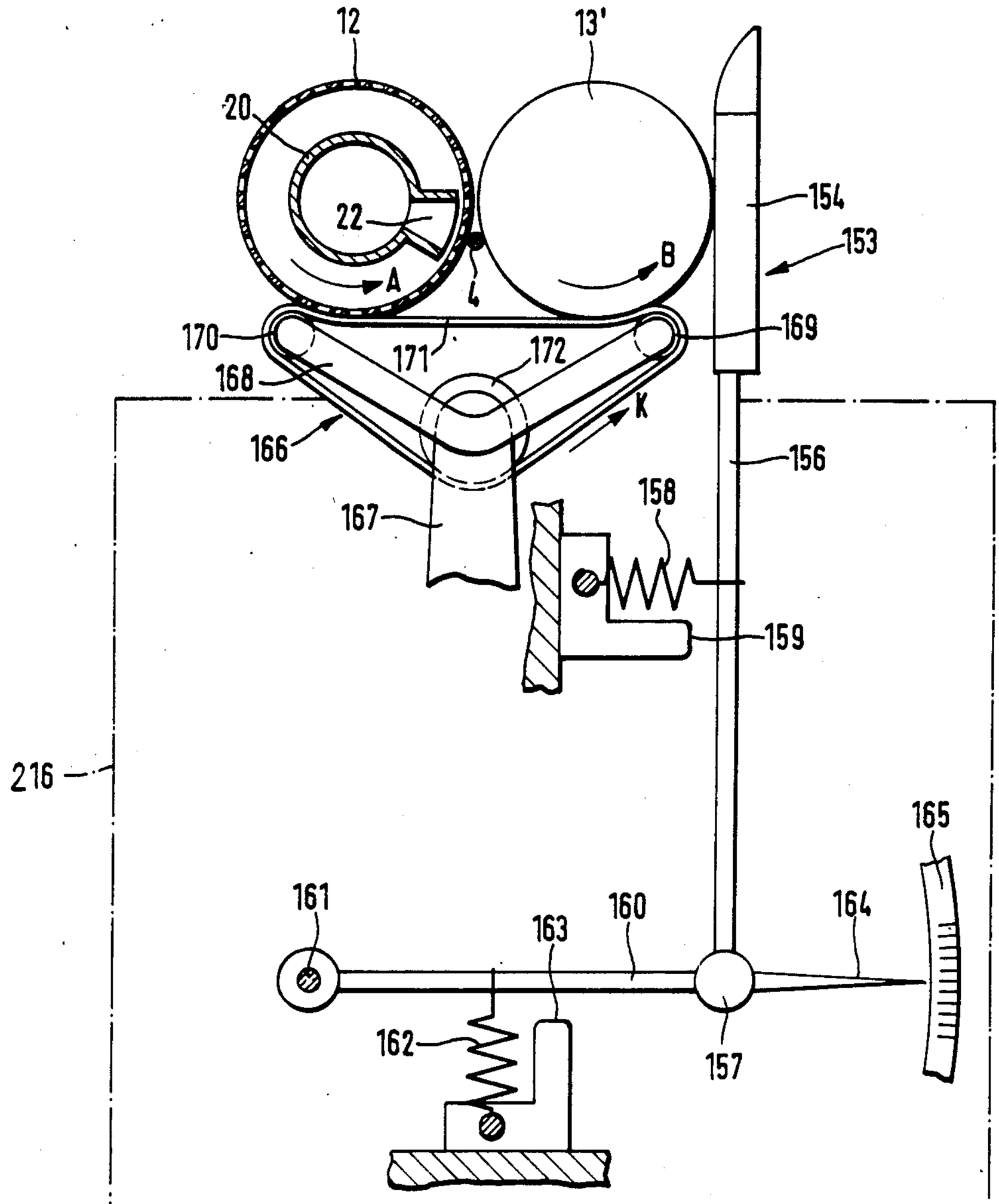

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Fig. 8

METHOD AND APPARATUS FOR OPERATING AN OPEN-END FRICTION SPINNING MACHINE

BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates to a method and apparatus for operating an open-end friction spinning machine having a plurality of spinning units. Each spinning unit includes a friction zone serving as a yarn forming point of region, a feeding and opening device for feeding the fibers to the friction zone, a suction device for holding the fibers and for forming yarn in the friction zone, and a withdrawal device for withdrawing the formed yarn out of the friction zone. The quality of the yarn spun at the spinning units is monitored by means of at least one measuring and evaluating device which triggers an adjusting of at least one parameter of the spinning conditions when there are deviations from the preset desired values of the yarn at the respective spinning unit.

A particular problem with one-end friction spinning is that it has been practically impossible to maintain the yarn quality of the formed yarn over longer periods of time. Differences in the yarn quality at the same spinning unit, as well as fluctuations of quality between yarns of different spinning units have been discovered from time to time. These quality differences are presumably primarily due to fluctuations in friction effect values within the friction zone over a course of time, which changes are difficult to exactly foresee. These fluctuations may be due to wear and tear or to accummulation of dirt particles upon the component parts forming the friction zone. Also, these fluctuations may be due to the characteristics of the fiber material and the spinning environment. For example, the spinning room humidity and temperature level and the amount of grease particles in the fibers being processed may affect the friction effect in the friction zone. In order to alleviate this problem, it has been proposed in accordance with pending commonly owned co-pending patent application Ser. No. 692,972, filed Jan. 22, 1985, to test the quality of the running yarn and upon detection of quality deviations or fluctuations, to accordingly change at least one parameter of the spinning conditions. In accordance with this proposal, a yarn tension sensor is arranged between a withdrawal device and the yarn forming region which monitors the yarn tension of the yarn for purposes of quality control. Conclusions can be drawn from changes in the yarn tension, regarding the quality and, for example, also regarding the applied yarn twist. At least one parameter of the spinning conditions may be changed upon undesirable deviations of the yarn tension in order to again return to the desired normal condition. This sort of indirect quality control of the formed yarn is easily realized and will also be sufficient in many instances. However, the danger does exist that this sort of quality control will no longer be sufficient under extreme circumstances, especially with high yarn withdrawal speeds and/or fine yarn numbers.

British Patent Specification No. 1,393,663 relates to an open-end rotor spinning machine and a device for measuring the count and twist factor of the material being spun. Although this arrangement utilizes the detection of the number of revolutions of a spinning rotor and the sliver feed and yarn withdrawal speeds to determine yarn twist in a rotor spinner, these are also indirect measurements of yarn twist. Because of the different operations of the yarn turning friction surface in rotor

spinners and open-end friction spinning machines using friction rollers or the like, such indirect measurements of the twist would not work with precision friction spinning machines of the type contemplated by the present invention.

One object of the invention is to provide a method of permitting a precise quality control of the spun yarn and to accommodate a correspondingly slight change or adjustment of at least one parameter of the spinning conditions.

This object is achieved according to the invention by detecting the yarn twist of the yarn produced at the spinning units and monitoring the same by means of a measuring and evaluating device.

An important criteria for the quality check of the yarn is thereby the ability to monitor the yarn twist according to preferred embodiments of the present invention. It is also contemplated to additionally test for yarn uniformity and/or yarn stability in certain preferred embodiments of the invention. The detection of yarn twist is important because it facilitates immediate signaling of any deviations in the friction effect of the friction zone of the respective spinning unit so that measures can be directly taken to eliminate any fluctuations in the friction effect.

In certain advantageous preferred embodiments of the invention, it is provided to monitor the yarn twist of a running yarn produced in the spinning units. This monitoring function can be conducted by either a yarn testing device arranged at each spinning unit, or by a servicing apparatus equipped with such type of yarn testing device which is periodically assigned to all spinning units according to certain embodiments of the invention. The first embodiments offer the advantage of a continuous monitoring, while the second embodiments advantageously keep operational expenditures to a minimum.

In a further development of preferred embodiments of the invention, it is provided to insert the yarn being monitored at a spinning unit into a movable servicing apparatus and to feed the same to a measuring device. This development takes into account that it becomes increasingly difficult to monitor the yarn twist in a yarn running with high production speeds. However, if the yarn is inserted into a movable servicing apparatus, its yarn twist can then be measured accordingly while the same runs very slowly or stands still all together. The arrangements necessary for this procedure need only be provided once per spinning machine, thereby keeping the operational costs in bearable limits.

In a further development of certain preferred embodiments of the invention, it is provided to continue the operation of the spinning unit during measurement. The yarn running through the servicing apparatus and produced during this measurement is returned to the spinning unit upon completion of the task and is wound upon a take-up spool of same. In these embodiments, the measuring of the yarn twist and the required adjusting of the spinning unit are accomplished without interrupting the yarn production of the respective spinning unit. These arrangements require a storage device to be provided in the servicing apparatus which safely accommodates the yarn continually produced during the measurement, and which allows subsequent withdrawal of the yarn out of the storage device.

In another embodiment of the invention, it is provided to discontinue the operation of the spinning unit

upon insertion of the yarn into the servicing apparatus, and upon the removal of a yarn test sample, to peform a piecing operation at the spinning unit. Because a servicing apparatus capable of performing a piecing process is generally contemplated for commercial friction spinning machines, this method can be accomplished relatively inexpensively.

In another development of preferred embodiments of the invention, it is provided to obtain a yarn test sample for measuring the yarn twist from a take-up spool of a non-operating spinning unit. This would further reduce the expense for any necessary equipment for removing a yarn sample, because a servicing apparatus can at least in part be utilized also which is commonly used for performing a piecing process. In this embodiment, it is also advantageous to remove a yarn sample from the take-up spool during a piercing process at this spinning unit. Then, in one working step, this servicing apparatus can accomplish not only the piecing, but also the measurement of the yarn twist, and additionally, as the need arises, attend to the adjustments of one or serveral parameters of the spinning conditions which are determined to be desired based on the measurement of the yarn twist.

In a further development of preferred embodiments of the invnetion, it is provided that the servicing apparatus establishes conditions at a particular spinning unit during the testing of the yarn twist prior to changing any parameters of the the actual value of one or several parameters of the spinning conditions thereof, and utilizes this actual value in the measuring and evaluating device. The possibility is thereby created to have the measuring and evaluating device determine which of the parameters are best to be adjusted for obtaining the desired results.

In a further development of preferred embodiments of the invention, it is provided that the measuring and evaluating device of the servicing apparatus compare the measured actual value to the preset limiting values of the parameters of the spinning conditions with regard to any necessary adjustments based upon the measured yarn twist. Further, the measuring and evaluating device discontinues operation of the spinning unit when values exceed the limiting values and/or marks the spinning unit that requires service. Prior to restarting the spinning unit and continuing of yarn production, the necessary service tasks are performed such as a cleaning process or treating or processing the surfaces of the friction zone at this spinning unit. These servicing tasks put the servicing apparatus into a position to meet the required spinning conditions.

In a further development of preferred embodiments of the invention, it is provided that the measuring and evaluating device of the servicing apparatus compares the measured actual value of the parameters of the spinning conditions with the preset limiting values of the parameters, in consideration of the necessary changes based upon the measured yarn twist. In addition, certain preferred embodiments include devices for assigning means for cleaning and/or post-treatment, especially of the friction zone, to the respective spinning unit requiring adjustment after having exceeded the limiting values. This part of the maintenance of the spinning unit is thereby also fully automated.

Further objects, features, and advantages of the present invention will become more apparent from the following description when taken with the accompanying drawings, which show for purposes of illustration only, several embodiments constructed in accordance with the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic partial front view of an open-end friction spinning machine having a movable servicing apparatus, constructed in accordance with preferred embodiments of the present invention;

FIG. **2** is an enlarged cross-sectional view through a spinning unit of the open-end friction spinning machine of FIG. **1**, in the area of the friction zone of one of the spinning units;

FIG. **3** is a schematic side view of a spinning unit and a schematical depiction of a servicing apparatus of the machine of FIG. **1**;

FIG. **4** is an enlarged cut-out sectional view of portions of the spinning unit and the servicing apparatus according to FIG. **3**;

FIG. **5** is a side sectional view of a mechanical untwisting arrangement from FIG. **4** for determining the yarn twist of a yarn sample;

FIG. **6** is a side cross-sectional view of an optical device for monitoring a yarn sample, constructed in accordance with another preferred embodiment of the invention;

FIG. **7** is a partial schematical, sectional view of a movable servicing apparatus including a yarn testing device adjustable to a spinning position with running yarn constructed in accordance with certain preferred embodiments of the invention; and

FIG. **8** is a partial schematical view of devices of a movable servicing apparatus for monitoring the friction values in the area of the friction zone and devices for the post-treatment of the friction zone constructed in accordance with certain preferred embodiments of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

The open-end friction spinning machine according to FIG. **1** includes a plurality of similarly configured spinning units **1** that are arranged next to one another in a row. Each machine side is preferably provided with a row of spinning units **1**.

Each spinning unit **1** is supplied a fiber band or sliver **3** out of a fiber sliver container **2** which is spun into yarn **4** in the spinning unit **1**. The yarn **4** is withdrawn by means of a withdrawal device including a drivable lower shaft **5** running through in longitudinal direction of the machine, and a pressure roller **6** assigned respectively to each spinning unit **1**. The withdrawn yarn **5** is subsequently wound onto a winding spool **7** whereby all winding spools **7** are driven by a drivable winding roller **8** running through in longitudinal direction of the machine.

As is shown in FIG. **1** only at a single spinning unit **1**, each spinning unit is provided with a feeding roller **9** which cooperates with a feeding table retrieving the fiber sliver **3** out of a fiber sliver container **2** and drawing the same into the spinning unit **1**. The feeding roller **9** offers the fiber sliver **3** to a faster rotating opening roller **10** which opens it into single fibers. The single fibers are fed via a fiber feeding duct **11** to the friction zone formed as a wedge-shaped gap **14** between two adjacently arranged rollers **12** and **13** driven in the same rotational direction. the formed yarn **4** is withdrawn in the longitudinal direction of gap **14**.

Further details of the spinning units **1** are shown in FIGS. **2** to **4**. The rollers **12** and **13** are configured as cylindrical sleeves directly borne by means of roller bearings **51** upon pipes **20** and **21**. Pipes **20** and **21** are connected via a connecting piece **60** and a control valve **61** to a suction line **62** which is connected to a channel running through in the machine longitudinal direction and having a vacuum source assigned at its end. Pipes **20** and **21**, located within rollers **12** and **13** and closed at the ends opposite the connecting piece **60**, include suction slots **22** and **23** delimited by webs projecting up close to closely adjacent the inside surfaces of rollers **12** and **13**. The suction slots **22** and **23** are directed towards the area of the wedge-shaped gap **14**. the shells or covers of rollers **12** and **13** are provided with perforations, at least in the area of the suction slots **22** and **23**, thereby accommodating sucking in of a suction air current penetrating the shells of rollers **12** and **13**.

The suction air current generated via the suction slots **22** and **23** of pipes **20** and **21** serves to retain the forming yarn in gap **14** and to feed fibers via the fiber feeding duct **11**. The fiber feeding duct **11** is located in a duct housing **18** and extends with a slot-like mouth **19** essentially parallel to and at a narrow distance to the wedge-shaped gap **14**.

The feeding roller **9** and the opening roller **10** are located underneath rollers **12** and **13** (FIG. **4**). The feeding roller **9** of a spinning unit **1** is borne at a pipe **65** fixedly attached to a fastening element **66** stationarily attached to the machine. The shaft of feeding roller **9** includes an electromagnetic coupling **67** connected via an electrical line **68** to a yarn beakage guard, not shown, which monitors the existence of the yarn **4**. Upon detection of breakage of a yarn **4** by the yarn breakage guard, the electromagnetic coupling **67** is opened, thereby separating the shaft of the feeding roller **9** from the toothed wheel **69** arranged thereupon. The toothed wheel **69**, together with a toothed wheel **70** arranged upon a driven shaft **71** and running through in longitudinal direction of the machine effects the drive of the feeding roller **9**.

The opening roller **10** is arranged in an opening roller housing **72** including a sleeve-type extension **73** which carries the shaft **74** of the opening roller **10**. Shaft **74** of the opening roller **10** protrudes out of this extension **73** and is driven by means of a tangential belt **75** running through in the longitudinal direction of the machine. The tangential belt **75** is loaded in the area of each shank **74**, with a respective tensioning roller **76** upon which the return driven drum **77** of the tangential belt **75** is guided. A dirt separator opening **80** is provided in the opening roller housing **72**, underneath the opening roller **10** which opening **80** segregates dirt particles out of the combed fiber sliver **3**. These particles reach a dirt removal conveyor **81** guided in a trough-like guidance element **82** in the longitudinal direction of the machine. The opening roller housing **72** contains a first segment **78** of the fiber feeding duct **11**, which continues in a second segment **79** that is provided in duct housing **18**. The duct housing **18** is attached to a machine frame cover **83** which is part of the spinning unit **1** and which is pivotable together with the duct housing **18** around axis **26** located below the feeding roller **9** and the opening roller **10**, for exposing the area of rollers **12** and **13**.

The two rollers **12** and **13** are driven in the same rotational direction (arrow direction A and B in FIG. **2**) via a drive belt **52** driven directly against their shell surfaces. The drive belt in turn is driven by a driving disc **53** attached to an electric motor **54** fixedly attached to a machine carrier part **26**. Each spinning unit **1** is thereby arranged with its own individual electric motor **54** for driving rollers **12** and **13**. The drive motor **54** is connected via an electric line **55** to a control unit **56** that adjusts the speed of the electric motor **54** to suitable values.

The yarn **4** is withdrawn in a direction from above to below the rollers **12, 13** which is opposite to the feeding direction of the fibers from below to above. An adjustable yarn withdrawal pipe **27** is arranged in the extension of the wedge-shaped gap **14**. This yarn withdrawal pipe **27** guides the finished yarn out of the spinning unit **1** and diverts the same upwardly towards the withdrawal device **5, 6** (FIG. **3**).

Each of the spinning units **1**, shown and described here, offers the possibility to individually adjust several parameters of the spinning conditions for obtaining an optimum total effect. The electric motors **54** of each spinning unit **1** can be controlled to a desired speed via control unit **56**. The control unit **56** is provided via line **57** with an adjusting switch **58** arranged at the outside of a machine frame cover **59**. The desired rotational speed of the electric motor **54** can be adjusted, and the electric motor **54** is switched on and switched off thereby. The electrovalve **61** is connected via an electrical line **63** to a regulator switch **64** also fixedly attached at the machine frame cover **59**. This switch **64** adjusts the desired opening position of the electrovalve **61** by means of which is regulated a defined vacuum pressure in the area of the wedge-shaped gap and thereby a defined vacuum air current. At the same time switch **64** is configured such that the electrovalve **61** can be completely closed thereby. A further possibility for an adjustment is offered by the yarn withdrawal pipe **27** which is adjustable in such a manner that the relative position of its entrance to the wedge-shaped gap **14** can be changed. By adjusting this entrance, the length of the yarn within the wedge-shaped gap **14** is set within which this yarn is thereby exposed to the friction effect. Furthermore, suction pipes **20** and **21** are adjustable axially and in circumferential direction allowing the adjustment of their relative position with respect to the wedge-shaped gap and to the opening **19** of the fiber feeding duct **11**, and thereby permitting proportioning the suction effect upon the forming yarn and the resulting friction effect in the wedge-shaped gap **14**. Additionally, it is contemplated to also adjust the opening cross sections of the suction slots **22** and **23**.

All of the above-indicated parameters of spinning conditions influence the friction effect upon the forming yarn **4** and thereby the yarn twist received by the yarn **4**. This yarn twist is measured and monitored as is described in detail below. Depending upon these measuring and monitoring results, the parameters are changed accordingly as deviations of the preset desired values are detected which are crucial for the friction effect and thereby for the introduced yarn twist. For simplicity purposes, the following only discusses regulation of the friction effect in adjusting switches **58** and **64** by means of adjusting the rotational speed of the electric motors **54** and thereby of rollers **12** and **13**, and also by adjusting the electrovalve **61**. Other means are also contemplated by the invention which simultaneously or separately change the above-indicated other parameters of the spinning conditions. The embodiments described in FIGS. **3** and **4** show the yarn twist of the forming yarn **4** in connection with correcting a yarn breakage. It can

here be provided that these tasks are performed in connection with either an inadvertently occurring yarn breakage, or an intentionally produced yarn breakage which occurs at certain predetermined time intervals.

The piecing process and also the measuring of the yarn twist, as well as, if necessary, adjustments in the spinning parameters are conducted by the movable servicing apparatus **16**. The servicing apparatus is movable on rails **15** by means of running wheels **17** of which at least one is driven, and is supported against rails **28** by means of contact rollers **29**. Rails **15** and guide rails **28** are attached above the spinning unit **1** and the take-up spool **7** at the machine frame **25**. During a yarn breakage, the take-up speed **7** of the respective spinning unit **1** lifts off the winding roller **8**. The take-up spool **7** is supported in a spool frame **30** pivotable about an axis **31** and is assigned an auxiliary winding roller **32** arranged upon lever **33** pivotable about an axis **34** of the servicing apparatus **16**. The auxiliary winding roller **32** is rotatable in both rotational directions and is pivotable in a range between the dotted-line position **35** and the position shown in solid lines. A yarn detector nozzle **36** is further assigned to the lifted take-up spool **7** and is pivotable about an axis **37** of the servicing apparatus **16** into position **39** indicated in dotted lines. Subsequently thereto, the take-up spool **7** is driven by means of the auxiliary winding roller **32** in uncoiling direction, thereby sucking the unwound yarn into mouth **38** of the yarn detector nozzle **36**. The nozzle **36** is then returned from its extended position. A yarn end **40**, indicated in dotted lines, is stretched between the auxiliary winding roller **32** and the mouth **38** of the yarn detector nozzle **36**. A clamping roller pair **41** originally in a moved-apart position is assigned to this yarn piece **40** and is closed upon clamping the yarn in between the rollers **41**. The pair of clamping rollers **41** are also drivable in both rotational directions. The rollers **41** are arranged on a lever **42** pivotable about an axis **43** of the servicing apparatus **16** into a position **44**, indicated in dotted lines, located opposite the exit opening of the yarn withdrawal channel **27**. In this position, a thread end **47** is made available. This thread end **47** is produced by means of a splicing apparatus located in the area of the mouth of the yarn detector nozzle **36**. The auxiliary winding roller **32** is driven in an unwinding direction during the movement of the pair of clamping rollers **41** into position **44**. During this open pivot movement, the yarn is positioned over a thread guide **46** into position **45**, indicated in dotted lines.

The yarn end **47** is introduced into the spinning unit **1** by further unwinding the yarn off the take-up spool **7** by driving the auxiliary winding roller **32** in unwinding direction, and by simultaneously driving the pair of clamping rollers **41** in unwinding direction, as can be seen in more detail in FIG. **4**. As shown in FIG. **4**, a junction **84** connects the yarn withdrawal pipe **27** in the area of its upwardly directed connecting piece and this junction is assigned a compressed air source line **85** of the servicing apparatus **16**. An air current is produced by blowing pressurized air into the area of the exit of the yarn withdrawal pipe **27** where yarn end **47** is taken on. The entering yarn end **47** is blown in over the area of the wedge-shaped gap **14**, against the normal withdrawal direction, by the entrance opening of the yarn withdrawal pipe **27** acting as blowing nozzle. The yarn end **47** is received by the mouth **87** of a suction pipe **88** arranged at the opposite end of the wedge-shaped gap **14**. This suction pipe **88** includes a connector **89** attached at the machine frame cover **59** and is coupled to a connector **90** of a suction duct **91** of the servicing apparatus **16**. During this return of the yarn end **47**, now positioned with its end **92** in the suction duct **91**, the servicing apparatus **16** switches off both the vacuum in the suction slots **22** and **23** and the electric motor **54** via control switches **58** and **64**. A device **93** is arranged in the suction duct **91** of the servicing apparatus **16**, which measures the twist of the yarn as is more clearly described later in connection with FIGS. **5** and **6**. After the return of the yarn, the same is prepared by fraying or otherwise treating the end for accommodating piecing whereupon the servicing apparatus **16** activates the actual piecing process. For this purpose, the servicing apparatus **16** again switches on the subpressure in the suction slots **22** and **23**, as well as the electric motor **54**. The servicing apparatus **16** also includes an auxiliary drive **95** which is assigned during the yarn piecing process to a toothed wheel **94** of the opening roller **9** accessible from the outside. This auxiliary drive controls the fiber feeding process until the running yarn, shown in FIG. **3** in a dotted line, has again closed the coupling **67** via the yarn breakage guard. During this piecing process, the pair of clamping rollers **41** located in the position **44** draw off the pieced yarn that is then wound upon take-up spool **7** by means of the auxiliary winding roller **32**.

The device as shown in FIG. **5** for measuring the yarn twist (described below) is arranged in a different location with another embodiment of the invention, more particularly in the area of the yarn detector nozzle **36**. In this case, the yarn end separated prior to the return of the yarn into the spinning unit **1**, is examined with respect to its twist.

Referring to FIG. **5**, the arrangement **93** includes a shearing or cutting device **96** at the area of its entrance that cuts off the yarn end **97** for conducting the subsequent further steps of the piecing process unimpeded by the yarn testing. The yarn piece end portion **97** to be tested is held at one end by means of a stationary yarn clamp **98**. The other end is held in a yarn clamp **99** formed with tong like clamping parts **100, 101**. One half **100** of the tong-like clamp is movable about a pivot axis **102** against the other half **101**. The yarn piece **97** is picked up by yarn clamp **99** while it is still under tension by the suction duct **91**. Yarn clamp **99** is pivotably borne upon a shaft **103** in a bearing housing **104**. The shaft is provided with a toothed wheel **105** engaging into a driven toothed wheel **106**. The yarn piece **97** is then wound up against its normal spinning rotation whereby the number of rotations required therefore is counted and transmitted via an electrical line **49** to an evaluating device **47** (FIG. **4**) of the servicing apparatus **16**.

This evaluating device **48** in turn is connected via one or several lines **50** to devices that adjust, especially via control switches **58** and **64**, one or several parameters of the spinning conditions upon detection of deviations from the desired yarn twist. The servicing apparatus **16** prior to adjusting the parameters of the spinning conditions, first checks the respective actual values and the evaluating device **48** takes these signals into account for a determination as to whether and which parameter to adjust. Such examination is conducted, in a simple manner, by having the servicing apparatus **16** with its control means also check the respective position of the control switches **58** and **64** to be inputted as signals into the evaluation device **48**, since the respective position of

the control switches **58** and **64** constitute an indication for the respective adjustment.

It is also contemplated in certain preferred embodiments of the invention to conduct a direct check of the respective parameters and recall the same by means of the servicing apparatus **16**. For example, each electric motor **54** is assigned a speed signal transmitter which value is recalled by the servicing apparatus **16**. Vacuum transmitters may be arranged in the pipes **20** and **21**, in a corresponding manner, which are also recalled by the servicing apparatus **16**. In the event the evaluating device **48** determines that a further adjustment of one or several parameters is no longer possible in the direction required to obtain the correct yarn twist, it is then provided in an embodiment which is not further described here, to discontinue the operation of the corresponding spinning unit and to mark the same as being unable to perform a piecing process if a servicing is not conducted first for restoring the spinning parameters. With still another embodiment, it is provided to equip the servicing apparatus **16** with means for automatically conducting a pretreatment of the spinning unit **1** for reinstating the actual values of the spinning parameters, for example, by way of cleaning and/or pretreatment of the friction zones. Such an arrangement is, for example, shown in FIG. **8** which will be discussed further below.

The measured values of the yarn twist are inputted into the evaluating device **48** and compared to stored values of a correctly twisted yarn. There are admissible tolerance ranges provided which, once exceeded, trigger the appropriate working steps for adjusting one or several parameters of the spinning conditions.

A number of options are provided for measuring the twist existing in the yarn, for example, mechanical, electrical, or optical means. An embodiment is shown in FIG. **6** which is provided with an optic-electrical measuring device **107**. A light source **109** is arranged in a housing **108** whereby a yarn piece **97** to be examined is located between a light source optic and a receiver optic. Following the receiver optic, the light rays **112** are transmitted to a photodiode **114** connected to a measuring device **115** which in turn is connected via electrical line **49** to the evaluating device **48** of the servicing apparatus **16**. A shadow **113** that corresponds to the diameter of the yarn piece **97** is projected upon the receiver optic. An evaluation regarding the yarn twist is made possible with the deivce if the fiber number is known. The fiber number itself can furthermore be determined by, for example, additionally providing an electrical device, namely a capacitance measuring device (capacitor). With a combination of these deivces, it is possible to determine the yarn twist especially in a running yarn.

In another embodiment, it is contemplated to twist the slowly running or still-standing yarn, for example, with an arrangement according to FIG. **5** which monitors the form changes occurring thereby, namely the cross-sectional enlargement or decrease, by means of, for example, a device according to FIG. **6**. The form change being dependent upon the twist, especially during a counter-clockwise rotation against the pre-existing spinning rotation, is an explicit indication of the pre-existing yarn twist. In another embodiment, an air vortex is provided as a twisting device that is produced by a twist nozzle or jet. Other embodiments monitor the behavior of the yarn during deformation, for example, during bending or shoving (compression loading) or the like, which in each instance is different depending upon the existing yarn twist in the yarn. By comparing these measurements to the behavior of a yarn exhibiting the desired yarn twist, one can then in each instance make a determination as to whether the measured yarn twist is within the permissible tolerance range or has already exceeded the same.

The embodiment according to FIGS. **4** and **5** provides that the measurement of the yarn twist is conducted by removal of a yarn sample during shut down of spinning unit **1**. Since this yarn test is conducted at the end of the yarn having been returned into the spinning unit **1**, one need not wait for the results of the measurement for a restarting spinning process. For example, it may be provided to conduct this measurement subsequent to the piecing while the servicing apparatus **16** has already commenced its monitoring travel. In this instance, and if it becomes a necessity, the required changes in the parameters of the spinning conditions are conducted by the servicing apparatus during its next round.

In another embodiment, it is provided to measure the yarn twist of the running yarn. With the embodiment according to FIG. **7**, the servicing apparatus **116** includes a corresponding yarn testing device **107** arranged upon a lever **119**. This device **107** on lever **119** is assigned to the running yarn located between the yarn withdrawal pipe **27** and withdrawal rollers **5, 6**. Lever **119** is pivotally supported at an axle **120** of the servicing apparatus **116** and is moveably controlled by means of an engaging element **121, 122** acting against the effects of a spring **123**. In this case, the necessary adjustments of the parameters of the spinning conditions are then conducted while the spinning unit is operational and continues the yarn production. The yarn testing apparatus **107**, in this instance, also monitors the performance of the adjustments made with respect to one or several spinning parameters in connection with the evaluating device **48**.

In a modification of the embodiment according to FIG. **7**, it is provided to equip each spinning unit **1** with a stationarily arranged yarn testing device **107** which performs a continuous monitoring of the running yarn. This yarn testing device, in a first embodiment, is connected to a central evaluating unit of the open end friction spinning machine. In another embodiment of this kind it is provided that the yarn testing device **107** is monitored during travel by an adjustable device of the servicing apparatus **116**.

In an embodiment not shown here, it is provided to equip the servicing apparatus **16** with elements to obtain a yarn sample out of the running production of a spinning unit for exposing the same to a yarn twist mesurement. In this case, the servicing apparatus **16** includes an arrangement for lifting off the take-up spool **7** from the winding roller **8**, more particularly off an auxiliary winding roller **32**. The yarn being further drawn out of the spinning unit by means of the withdrawal device **5, 6** is introduced into the servicing apparatus **16** and stored there temporarily. At this point, it is possible to stop a yarn piece or to allow only slow motion in order to conduct the measurement of the yarn twist. Upon completion of the yarn twist measurement, the yarn is then returned to the spinning unit **1** whereby the take-up spool is first driven with an increased rotational speed by the servicing apparatus **16** until the yarn length produced during the work conducted is again withdrawn out of the servicing apparatus **16**. In this embodiment, a changing of the spinning parameters by the

servicing apparatus **16** is also conducted without shut down of a spinning unit **1**.

In another embodiment not shown here, it is provided that the servicing apparatus receives the running yarn in front of the take-up spool **7**, separates it there, and allows the continuously forming yarn to pass into the servicing apparatus. The spinning unit discontinues operation upon having received a sufficiently long enough yarn piece for conducting the yarn twist measurement. After a necessary adjustment of one or several parameters of the spinning conditions, the servicing apparatus then conducts a piecing process in the manner discussed based upon FIGS. **3** and **4**, however, without later measuring the yarn twist again.

As has been noted above, the servicing apparatus is advantageously equipped with means for checking the actual values of one or several of the parameters of the spinning conditions and inputting these values into the evaluating device. Such an arrangement is described in FIG. **8**. In the embodiment according to FIG. **8** and in modification of the embodiment according to FIG. **2**, there are provided two different rollers **12** and **13'** whereby only one of the rollers rotatating into the wedge-shaped gap (in arrow direction A) is arranged as a suction roller. Therefore, this roller **12** includes a perforated shell and a suction pipe **20** having a suction slot **22**. The roller **13'**, rotating out of the wedge-shaped gap, includes a closed shell surface as is shown in FIG. **8**. The servicing apparatus **216** includes a device **153** for monitoring the friction characteristics of a roller **131** having a closed shell surface, a so-called solid roller. Therefore, the device **153** measures the roller **13**'s existing friction value. This device **153** includes a sliding element **154** which has a top surface made out of a material having a defined friction value with respect to the top surface of roller **13'**. This sliding element **154** is arranged upon a lever arm **156** supported via a pivot joint **157** at a lever **160** which is pivotable about an axis **161** of the servicing apparatus **16** against the effect of a tension spring **162**. Lever **156** includes a tension spring **158** tensioning the sliding element against the shell surface of roller **13'**. The lever **160** is provided with a finger **164** positioned opposite a measuring device shown as a scale **165**. The movement of lever **160** against the effect of spring **162** due to the friction effect between the shell surface of roller **13'** and the sliding element **154**, results in a direct indication of the friction effect of the shell surface of roller **13'**.

In the case where the friction effect of roller **13'** is determined by the shown device **153** to be insufficient and in fact below a predetermined range, a device **166** of the servicing apparatus **216** is then assigned to the shell surfaces of rollers **12** and **13'** for post-treating the friction surfaces (shell surfaces of rollers **12** and **13'**). The device **166** includes a lever movable out of the servicing apparatus **216** which carries two deflection rollers **169** and **170** upon a fork **168** surrounded by a band **171** that also surrounds friction roller **172**. The friction roller **172** is arranged at lever **167** which is connected, in a not further described manner, to a drive motor. The two deflection rollers **169** and **170** are arranged in such a distance from each other so that the band may easily surround both rollers **12** and **13'**. The band **171** which has a fine friction coating is rotatable against the rotational direction of rollers **12** and **13'** in arrow direction K whereby the shell surfaces of rollers **12** and **13'** are, for example, somewhat roughened or, if necessary, also polished.

Although the present invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only, and is not to be taken by way of limitation. The spirit and scope of the present invention are to be limited only by the terms of the appended claims.

What is claimed:

1. A method for operating an open-end friction spinning machine of the type having a plurality of spinning units with:

drivable friction surface means defining a yarn formation zone; and

feeding means for feeding fibers to the yarn formation zone, said fibers passing through the yarn formation zone along a predetermined path,

said process comprising:

monitoring yarn twist of yarn formed at a spinning unit;

comparing the monitored yarn twist with a predetermined desired yarn twist value; and

adjusting at least one parameter of spinning conditions in response to deviations from the predetermined desired yarn twist without changing the predetermined path along which the fibers pass through the yarn formation zone.

2. A method as in claim **1**, wherein said monitoring includes measuring the yarn twist of the yarn running through and formed in the spinning unit without interrupting operation of the spinning unit.

3. A method as in claim **1**, wherein said monitoring includes inserting the yarn of a monitored spinning unit into a movable servicing apparatus and feeding said yarn to a measuring device for measuring said yarn twist.

4. A method as in claim **3**, including

detecting an actual value of at least one of the parameters of spinning conditions by the servicing apparatus during the monitoring of the yarn twist and prior to adjusting at least one of the parameters of the spinning conditions of the respective spinning unit; and

utilizing this actual value in the adjusting.

5. A method as in claim **4**, wherein said utilizing includes comparing the detected actual value with predetermined limiting values of the parameters of the spinning conditions taking into account necessary adjustments based upon the monitored yarn twist, and

further comprising discontinuing operation of the spinning unit when the limiting values are exceeded indicating an adjustment requirement.

6. A method as in claim **4**, wherein said utilizing includes comparing the detected actual value with predetermined limiting values of the parameters of the spinning conditions taking into account necessary adjustments based upon the monitored yarn twist, and

further comprising identifying the respective spinning unit requiring the necessary adjustments.

7. A method as in claim **4**, wherein said utilizing includes comparing the detected actual value with predetermined limiting values of the parameters of the spinning conditions taking into account necessary adjustments based upon the monitored yarn twist, and wherein said adjusting includes assigning cleaning means for cleaning of the spinning unit particularly in a friction zone when the limiting values are exceeded making an adjustment necessary.

8. A method as in claim **4**, wherein said utilizing includes comparing the detected actual value with pre-

determined limiting values of the parameters of the spinning conditions taking into account necessary adjustments based upon the detected yarn twist, and wherein said adjusting includes assigning post-treatment means for the spinning unit post-treating particularly in a friction zone when limiting values are exceeded making an adjustment necessary.

9. A method as in claim **3**, including:

continuing the operation of the spinning unit during measuring by the measuring device;

returning yarn produced during measuring from the servicing apparatus to the spinning unit upon completion of the measurement; and

winding this yarn that is returned upon a take-up spool of the spinning unit.

10. A method as in claim **9**, including:

detecting an actual value of at least one of the parameters of spinning conditions by the servicing apparatus during the monitoring of the yarn twist and prior to adjusting at least one of the parameters of the spinning conditions of the respective spinning units; and

utilizing this actual value in the adjusting.

11. A method as in claim **10**, wherein said utilizing includes comparing the detected actual value with predetermined limiting value of the parameters of the spinning conditions taking into account necessary adjustments based upon the monitored yarn twist, and

further comprising discontinuing operation of the spinning unit when the limiting values are exceeded indicating an adjustment requirement.

12. A method as in claim **10**, wherein said utilizing includes comparing the detected actual value with predetermined limiting value of the parameters of the spinning conditions taking into account necessary adjustments based upon the monitored yarn twist, and

further comprising identifying the respective spinning unit requiring the necessary adjustments.

13. A method as in claim **10**, wherein said utilizing includes comparing the detected actual value with predetermined limiting values of the parameters of the spinning conditions taking into account necessary adjustments based upon the detected yarn twist, and wherein said adjusting includes assigning cleaning means for cleaning of the spinning unit particularly in a friction zone when the limiting values are exceeded making an adjustment necessary.

14. A method as in claim **10**, wherein said utilizing includes comparing the detected actual value with predetermined limiting values of the parameters of the spinning conditions taking into account necessary adjustments based upon the detected yarn twist, and wherein said adjusting includes assigning post-treatment means for the spinning unit post-treating particularly in a friction zone when the limiting values are exceeded making an adjustment necessary.

15. A method as in claim **3**, including switching off the spinning unit following the insertion of the yarn into the servicing apparatus, and resuming the spinning unit operation upon removal of a yarn test sample.

16. A method as in claim **3**, including gathering a yarn sample from a take-up spool of a switched off spinning unit for measuring the yarn twist.

17. A method as in claim **16**, wherein said gathering of a yarn sample off the take-up spool of a spinning unit is conducted during one of the following, a piecing process and a doffing process, at the respective associated spinning unit.

18. A method as in claim **3**, wherein said monitoring includes mechanically analyzing said yarn twist.

19. A method as in claim **3**, wherein said monitoring includes optically analyzing said yarn twist.

20. An open-end friction spinning machine with a plurality of spinning units comprising:

drivable friction surface means defining a yarn formation zone;

feeding means for feeding fibers to the yarn formation zone, said fibers passing through the yarn formation zone along a predetermined path;

monitoring means for monitoring yarn twist of yarn at the spinning units;

comparing means for comparing the monitored yarn twist with a predetermined desired yarn twist value; and

adjusting means for adjusting at least one parameter of spinning conditions in response to deviations from the predetermined desired yarn twist value without changing the predetermined path along which the fibers pass through the yarn formation zone.

21. An apparatus as in claim **20**, wherein said monitoring means is provided at a movable servicing means which includes means for receiving the yarn to be monitored and which is selectively movable to respective areas of the spinning units.

22. A method for operating an open-end friction spinning machine of the type having a plurality of spinning units with:

drivable friction surface means defining a yarn formation zone; and

feeding means for feeding fibers to the yarn formation zone,

said process comprising:

monitoring yarn twist of yarn formed at a spinning unit;

comparing the monitored yarn twist with a predetermined desired yarn twist value; and

adjusting at least one parameter of spinning conditions in response to deviations from the predetermined desired yarn twist without changing the positioning of the drivable friction surface means defining the yarn formation zone.

23. A method as in claim **1**, wherein said monitoring of the yarn twist includes monitoring a cross-section of the yarn.

24. A method as in claim **23**, wherein said monitoring of the yarn twist further includes determining a value of the number of fibers in the yarn.

25. An apparatus as in claim **20**, wherein said monitoring means includes means for monitoring the cross-section of the yarn.

26. An apparatus as in claim **25**, wherein said monitoring means further includes means for determining a value of the number of fibers in the yarn.

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